Claims 39-46

Claims 39-40 and 43-46 have been rejected as being obvious over U.S. Patent No. 6,422,395 to Verdegan in view of U.S. Patent No. 6,206,205 to Durre and U.S. Patent No. 4,464,263 to Brownell. Claims 41-42 have been rejected as being obvious over U.S. Patent No. 6,422,395 to Verdegan, U.S. Patent No. 6,206,205 to Durre, U.S. Patent No. 4,464,263 to Brownell and further in view of U.S. Patent No. 5,599,449 to Gnamm. These claims set forth that the support screen comprises a sheet of screen material having a length approximately equal to the circumferential dimension of the filter media plus a seam allowance, that the sheet of screen material has lateral edges joined together at a side seam, and that the support screen is thermally bonded to each of the peaks thereby exoskeletonally supporting the pleats in a spaced and non-collapsed condition.

The Examiner contends that it would have been obvious to replace the metal liner 40 shown in the Verdegan filter element 30 with the support tube shown in Durre "to provide an alternative design and improved exoskeleton which would provide sufficient support for the pleats of the filter media" and "at the same time, provide a structure which is less expensive to manufacture." The Examiner admits that his proposed Verdegan/Durre combination does not show "thermal bonding" of the support screen to the filter peaks, but points to Brownell to make up for this discrepancy. Specifically, he says it would have been obvious to incorporate the Brownell bonding method to prevent "collapse and movement of the pleats of the filter media, without the added expense of adhesives."

It is noted that in the Durre support tube, "the seam region 50 is not welded or bent" and "[t]he side edges merely abut at this location." Accordingly, Durre does not show or suggest a "seam allowance."[7] Additionally or alternatively, Brownell teaches liquid plastic which foams and solidifies around the filter peaks - it does not show or suggest thermal bonding. As for Gnamm, its lateral edges 46 and 48 are purposely left unattached "in order to be able to expand the filter element elastically for the purpose of fitting in a circumferential groove."

Claim 52

Claim 52 has been rejected as being obvious over U.S. Patent No. 6,422,395 to Verdegan in view of U.S. Patent No. 4,464,263 to Brownell and further in view of U.S. Patent No. 5,552,048 to Miller. Claim 52 sets forth that the exoskeleton comprises a

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combination.

7. In fact, Durre is specifically directed to applications requiring moderately high collapse strength (on the order of 300 psi to 600 psi) where the thickness of the support tube "does not lend itself to an overlapped or lock seam type of joint."

support screen that is non-adhesively bonded to each of the radially inward peaks and that has a first set of cords extending in a first direction, a second set of cords extending in a second direction and intersecting with the first set of cords, and openings defined therebetween.

As was discussed above, Verdegan discloses a perforated metal liner 40 which the Examiner considers part of the prior art device which remains when the filter media 30 is replaced with the filter media 70. Brownell discloses a perforated foam shield 16 in which the radially outer peaks of the filter media are embedded during the molding of the foam shield. Miller discloses an elongated strip 70 which is spirally wrapped around the filter media.

The Examiner contends that it would have been obvious to replace the Verdegan perforated metal liner 40 with the Brownell foam shield 16 and then somehow "modify" the Brownell foam shield "by substituting it with the embodiment (wrap 70) taught by Miller." However, if the Verdegan metal liner 40 is a non-filter part of the prior art device, there is no reason to provide the Verdegan filter with a Brownell-like foam shield. Moreover, the prior art provides no suggestion on how the Brownell foam shield could be made with the claimed cord construction, especially one providing at least 50% open flow area and a tight array of attachment points so that the filter media is sufficiently supported without a central support tube. The Brownell method of attachment involves filling a mold with a plastic material, suspending the peaks of the filter pleats adjacent the plastic material, foaming the plastic material and expanding its volume so that it contacts the filter pleats, and then solidifying the plastic material to embed the pleats therein. It is difficult (or, perhaps more accurately, impossible) to imagine how such an attachment method could be employed with a cord construction.

Claims 26 and 59-63

Claims 26 and 59-60 have been rejected as being obvious over U.S. Patent No. 6,422,395 to Verdegan in view of U.S. Patent No. 5,552,048 to Miller and U.S. Patent No. 4,046,697 to Briggs. Claims 61-63 have been rejected as being obvious over U.S. Patent No. 6,422,395 to Verdegan, U.S. Patent No. 5,552,048 to Miller, U.S. Patent No. 4,046,697 to Briggs and further in view of U.S. Patent No. 5,814,219 to Friedmann. These claims set forth that the exoskeleton support structure comprises a support screen that is non-adhesively attached to the peaks. The support screen has a first set of cords extending in a first direction, a second set of cords extending in a second direction and intersecting with the first set of cords, and openings defined therebetween. The cords are attached to each of the radially-outer peaks or each of the radially-inner peaks thereby exoskeletonally supporting the pleats in an appropriately spaced and non-collapsed condition.

The Examiner contends that it would have been obvious to replace the Verdegan perforated metal sheet 40 with the Miller spiral wrap, and then to modify the replacement

spiral wrap to include the Briggs textile body 24 "in order to provide the optimum spacing/open flow area for fluid flow between the pleats of the filter medium." For the reasons discussed above, the proposed Verdegan/Miller combination is not believed to be obvious. Moreover, Briggs discloses a filter comprising a perforated center tube and "a loosely woven textile body" that is "adhesively bonded to certain of the outer folds." Briggs teaches that adhesive bonding is possible with its textile body 24 because "the amount of adhesive applied to the filter will be far less" than with cover members of conventional types. Accordingly, any fair incorporation of the Briggs teachings would result in the support screen being adhesively attached to the filter media.

With particular reference to claims 61-63, they set forth that the support screen comprises a sheet of mesh material having lateral edges joined together at a side seam which extends substantially the length of the longitudinal axis of the filter media. The Examiner appears to admit that this feature is not shown or suggested by the Verdegan/Miller/Briggs combination, but points to Friedman to cure this shortcoming. Friedman discloses a sheet 40 (comprising a plurality of randomly arranged plastic filaments bonded together to form a plurality of randomly spaced and shaped openings) which is "adhesively affixed to the pleat tips for maintaining spacing of the tips." Thus, Friedman does not overcome the discrepancies of the base Verdegan/Miller/Briggs and, moreover, teaches adhesive attachment.

Claims 4-6

Claims 4-5 have been rejected as being obvious over U.S. Patent No. 6,422,395 to Verdegan, U.S. Patent No. 4,464,263 to Brownell, U.S. Patent No. 3,505,794 to Nutter, and further in view of U.S. Patent No. 5,552,048 to Miller, U.S. Patent No. 6,454,870 to Castellanos, and U.S. Patent No. 4,046,697 to Briggs. Claim 6 has been rejected as being obvious over U.S. Patent No. 6,422,395 to Verdegan, U.S. Patent No. 4,464,263 to Brownell, U.S. Patent No. 3,505,794 to Nutter, U.S. Patent No. 5,552,048 to Miller, U.S. Patent No. 6,454,870 to Castellanos, and U.S. Patent No. 4,046,697 to Briggs, and further in view of U.S. Patent No. 4,735,720 to Kersting. These claims set forth that the support screen comprises a thermal-bondable mesh having cords which form a grid of approximately about 0.060 inch to about 0.150 inch by 0.060 inch to about 0.150 inch openings which are aligned with a longitudinal axis of the filter media.

As was explained above in connection with claims 1 and 2 (from which claims 4-6 depend) the proposed Verdegan/Brownell/Nutter combination is not believed to be obvious. Whatever teachings Miller, Castellanos, and/or Briggs may or may not offer regarding screen mesh, and whatever teachings Kersting may or may not offer regarding side seams, they do not cure the discrepancies in the Verdegan/Brownell/Nutter combination. Moreover, the Miller spiral wrap does not disclose grid openings which are aligned with the longitudinal axis of the filter medial and Briggs discloses adhesive attachment.

Claims 20-23 and 25

Claims 20, 22 and 25 have been rejected as being obvious over U.S. Patent No. 4,735,720 to Kersting. Claim 23 has been rejected as being obvious over U.S. Patent No. 4,735,720 to Kersting in view of U.S. Patent No. 4,464,263 to Brownell. Claims 20, 22 and 23 set forth a side seam comprising an adhesive bead which encapsulates all of the layers of the distal ends of the end pleats and which extends radially inward between the respective sidewalls of the end pleats. Claims 25 sets forth a side seam comprising an adhesive bead which extends radially inward between the endmost sidewalls of the end pleats and circumferentially between endmost radially outward peaks of the two end pleats. Kersting, in contrast, does not teach a bead, but rather teaches a bar-shaped mass which is formed by introducing a liquid resin into a mold cavity. The claims now emphasize this distinction by reciting that the adhesive bead is formed by dispensing an adhesive from a dispenser, as such dispensing results in the bead being structurally different than the Kersting molded bar.

Conclusion

In view of the foregoing, this application is now believed to be in a condition for allowance and an early action to that effect is earnestly solicited.

Respectfully submitted,

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Amendments to the Claims

1. (Previously Presented) A microfilter element for removing impurities in the range of about 0.5 μm to about 25.0 μm from aviation fuel, said element comprising a cylindrical filter media and an exoskeleton for the filter media;

the filter media including a filtration layer sandwiched between inner and outer layers;

the filtration layer being made of fiberglass or at least one polymer;

the inner and outer layers being made of a non-woven polymer;

the layers of the filter media being folded into a plurality of longitudinally-extending pleats with a density of about 8 or more pleats per inner diameter inch;

the exoskeleton comprising a support screen bonded to peaks of the pleats to support the pleats in an appropriately spaced and non-collapsed condition;

the support screen providing at least 50% open flow area and a tight array of attachment points so that the filter media is sufficiently supported without having cellulose-fiber and/or woven-mesh endoskeleton support layers.

2. (Original) A microfilter element as set forth in claim 1, wherein the layers of the filter media consist essentially of the filtration layer, the inner layer, and the outer layer.

3. (Original) A microfilter element as set forth in claim 2, wherein the filtration layer has a thickness of about 0.015 inch to about 0.035 inch and wherein the inner and outer layers are each have a thickness of about 0.008 to about 0.017 inch.

4. (Original) A microfilter element as set forth in claim 2, wherein the support screen comprises a thermal-bondable mesh having cords which form a grid of approximately about 0.060 inch to about 0.150 inch by 0.060 inch to about 0.150 inch openings which are aligned with a longitudinal axis of the filter media.

5. (Original) A microfilter element as set forth in claim 4, wherein the support screen is bonded to the radially outer peaks of the filter media.

6. (Original) A microfilter element as set forth in claim 4, wherein the plurality of longitudinally-extending pleats include two end pleats joined together at a side seam and wherein the side seam comprises an adhesive bead which encapsulates all of the layers in distal ends of the end pleats.

7. (Previously Presented) A microfilter element as set forth in claim 1, wherein the plurality of longitudinally-extending pleats include two end pleats joined together at a side seam, wherein the side seam comprises an adhesive bead which encapsulates all of the layers in distal ends of the end pleats, and wherein the adhesive bead extends radially inward between the end pleats.

8. (Canceled)

9. (Canceled)

10. (Previously Presented) A filter element comprising a cylindrical filter media and an exoskeleton support structure surrounding the filter media;

the filter media being formed from only cellulose-fiber-free and woven-mesh-free layers including a filtration layer sandwiched between inner and outer layers;

the layers of the filter media being folded into a plurality of longitudinally-extending pleats having radially-inner peaks defining an inner diameter, radially-outer peaks defining an outer diameter, and side walls extending therebetween;

the exoskeleton support structure being attached to the radially-outer peaks and/or radially-inner peaks in such a manner that the filter media is sufficiently supported without cellulose-fiber and/or woven-mesh endoskeleton support layers;

wherein the layers of the filter media consist essentially of the filtration layer, the inner layer, and the outer layer.

11. (Canceled)

12. (Canceled)

13. (Canceled)

14. (Canceled)

15. (Canceled)

16. (Canceled)

17. (Canceled)

18. (Currently Amended) A filter element comprising a cylindrical filter media and an exoskeleton support structure supporting the filter media;

the filter media being formed from a plurality of layers folded into a plurality of longitudinally-extending pleats having radially-inner peaks defining an inner diameter, radially-outer peaks defining an outer diameter, and side walls extending therebetween;

the filter media having a pleat density of about 12 or more pleats per inner diameter inch; ~~and~~

the height of each pleat being substantially equal or less than the difference between the outer diameter and the inner diameter; and

the exoskeleton support structure being attached to radially-outer peaks or radially-inner peaks of the filter media.

19. (Previously Presented) A filter element as set forth in claim 18, wherein the filter media has a pleat density of about 13 pleats per inner diameter inch.

20. (Currently Amended) A cylindrical filter media comprising a plurality of longitudinally extending pleats and a side seam;

the plurality of pleats including two end pleats each including a filtration layer, an inner layer and an outer layer;

the two end pleats each having a distal end, a radially-inner peak, an endmost sidewall extending from the distal end to the radially-inner peak, and a radially outer peak;

the sidewalls being positioned adjacent each other and the distal ends being positioned radially outward relative to the radially-inward peaks; and

the side seam comprising an adhesive bead having a continuous mass which encapsulates all of the layers in the distal ends of the end pleats;

wherein the continuous mass extends radially inward between the respective sidewalls of the end pleats;

wherein the adhesive bead is formed by dispensing an adhesive from a dispenser.

21. (Canceled)

22. (Previously Presented) A cylindrical filter media as set forth in claim 20, wherein the adhesive bead extends circumferentially between the radially outward peaks of the two end pleats.

23. (Original) A filter element comprising the filter media of claim 20 and an exoskeleton support structure surrounding the filter media and attached to radially outward peaks of each of the pleats.

24. (Canceled)

25. (Currently Amended) A cylindrical filter media comprising a plurality of longitudinally extending pleats and a side seam;

the plurality of pleats including two end pleats each having a distal end, a radially-inner peak, an endmost sidewall extending from the distal end to the radially-inner peak, and a radially outer peak;

the sidewalls being positioned adjacent each other and the distal ends being positioned radially outward relative to the radially-inward peaks; and

the side seam comprising an adhesive bead having a continuous mass which extends radially inward between the endmost sidewalls of the end pleats and circumferentially between endmost radially outward peaks of the two end pleats;

wherein the adhesive bead is formed by dispensing an adhesive from a dispenser.

26. (Previously Presented) A filter element comprising a cylindrical filter media and an exoskeleton support structure for the filter media;

the cylindrical filter media comprising a plurality of longitudinally-extending pleats having radially-inner peaks defining an inner diameter, radially-outer peaks defining an outer diameter, and side walls extending therebetween;

the exoskeleton support structure comprising a support screen having a first set of cords extending in a first direction, a second set of cords extending in a second direction and intersecting with the first set of cords, and openings defined therebetween;

the cords being attached to each of the radially-outer peaks or each of the radially-inner peaks thereby exoskeletonally supporting the pleats in an appropriately spaced and non-collapsed condition;

adjacent cords in the first set being separated from each other by a distance d_1, adjacent cords in the second set being separated from each other by a distance d_2, and adjacent radially-outer peaks being separated from each other by a distance d_{pleat}; and

the distance d_1 between the first set of cords being about half to about twice the distance d_{pleat} between adjacent radially-outer peaks;

wherein the support screen is non-adhesively attached to the peaks.

27. (Canceled)

28. (Canceled)

29. (Canceled)

30. (Canceled)

31. (Canceled)

32. (Canceled)

33. (Canceled)

34. (Canceled)

35. (Canceled)

36. (Canceled)

37. (Canceled)

38. (Canceled)

39. (Original) A filter element comprising a cylindrical filter media and an exoskeleton support screen for the filter media;

the cylindrical filter media comprising a plurality of longitudinally-extending pleats having radially-inner peaks defining an inner diameter, radially-outer peaks defining an outer diameter, and side walls extending therebetween;

the support screen comprising a sheet of screen material having a width approximately equal to the axial dimension of the filter media and a length approximately equal to the circumferential dimension of the filter media plus a seam allowance;

the sheet of screen material having lateral edges joined together at a side seam; and

the support screen being thermally bonded to each of the radially-outer peaks or each of the radially-inner peaks thereby exoskeletonally supporting the pleats in a spaced and non-collapsed condition.

40. (Previously Presented) A filter element as set forth in claim 39, wherein the side seam extends substantially parallel to a longitudinal axis of the filter media.

41. (Previously Presented) A filter element as set forth in claim 39, wherein the lateral edges overlap and are non-adhesively thermally bonded together.

42. (Original) A filter element as set forth in claim 41, wherein the support screen is made of a PVC coated fiberglass mesh.

43. (Original) A filter element as set forth in claim 39, wherein the support screen is made of a PVC coated fiberglass mesh.

44. (Previously Presented) A filter element as set forth in claim 39, wherein the sheet of screen material is rectangular in shape prior to its lateral edges being joined together at the side seam.

45. (Original) A filter element as set forth in claim 39, wherein the support screen is thermally bonded to each of the radially-outer peaks.

46. (Previously Presented) A filter element comprising a cylindrical filter media and an exoskeleton support screen for the filter media;

the cylindrical filter media comprising a plurality of longitudinally-extending pleats having radially-inner peaks defining an inner diameter, radially-outer peaks defining an outer diameter, and side walls extending therebetween;

the support screen comprising a sheet of screen material having a width approximately equal to the axial dimension of the filter media and a length approximately equal to the circumferential dimension of the filter media plus a seam allowance;

the sheet of screen material having lateral edges joined together at a side seam; and

the support screen being thermally bonded to each of the radially-inner peaks thereby exoskeletonally supporting the pleats in a spaced and non-collapsed condition.

47. (Canceled)

48. (Canceled)

49. (Canceled)

50. (Canceled)

51. (Canceled)

52. (Previously Presented) A coalescer element for removing free water and particulates from aviation fuel, said element comprising a cylindrical media and an exoskeleton for the media;

the cylindrical media comprising a plurality of longitudinally-extending pleats having radially inward peaks;

the exoskeleton comprising a support screen having a first set of cords extending in a first direction, a second set of cords extending in a second direction and intersecting with the first set of cords, and openings defined therebetween;

the support screen being non-adhesively bonded to each of the radially inward peaks of the pleats to support the pleats in an appropriately spaced and non-collapsed condition; and

the support screen providing at least 50% open flow area and a tight array of attachment points so that the filter media is sufficiently supported without a central support tube.

53. (Previously Presented) A filter element as set forth in claim 10, wherein the filtration layer is made of at least one of fiberglass, nylon, polyamide, polyester, polyethylene, polypropylene, or mixtures thereof.

54. (Previously Presented) A filter element as set forth in claim 10, wherein the inner and outer layers each have a thickness of less than about 0.030 inches.

55. (Previously Presented) A filter element as set forth in claim 10, wherein the inner and outer layers are each made of a non-woven polymer.

56. (Previously Presented) A filter element as set forth in claim 10, wherein the layers of the filter media consist essentially of the filtration layer, the inner layer, and the outer layer, wherein the filtration layer is made of at least one of fiberglass, nylon, polyamide, polyester, polyethylene, polypropylene, or mixtures thereof, and wherein the inner and outer layers each have a thickness less than about 0.030 inches and are made of a non-woven polymer.

57. (Previously Presented) A filter element as set forth in claim 56, wherein the filter media has a pleat density of about 8 or more pleats per inner diameter inch.

58. (Previously Presented) A filter element as set forth in claim 10, wherein the filter media has a pleat density of about 8 or more pleats per inner diameter inch.

59. (Previously Presented) A filter element as set forth in claim 26, wherein the support screen is thermally bonded to the peaks.

60. (Previously Presented) A filter element as set forth in claim 59, wherein the support screen is made of a PVC coated fiberglass mesh.

61. (Previously Presented) A filter element as set forth in claim 26, wherein the support screen comprises a sheet of mesh material having lateral edges joined together at a side seam which extends substantially the length of the longitudinal axis of the filter media.

62. (Previously Presented) A filter element as set forth in claim 61, wherein the lateral edges overlap and are thermally bonded together.

63. (Previously Presented) A filter element as set forth in claim 62, wherein the support screen is made of a PVC coated fiberglass mesh.

64. (Previously Presented) A microfilter element for removing impurities in the range of about 0.5 µm to about 25.0 µm from hydrocarbon fuel, said element comprising a cylindrical filter media and an exoskeleton for the filter media;

the filter media including a filtration layer sandwiched between inner and outer layers;

the filtration layer being made of fiberglass or at least one polymer;

the inner and outer layers being made of a non-woven polymer;

the layers of the filter media being folded into a plurality of longitudinally-extending pleats with a density of about 8 or more pleats per inner diameter inch;

the exoskeleton comprising a support screen bonded to peaks of the pleats to support the pleats in an appropriately spaced and non-collapsed condition;

the support screen providing at least 50% open flow area and a tight array of attachment points so that the filter media is sufficiently supported without having cellulose-fiber and/or woven-mesh endoskeleton support layers.

65. (Previously Presented) A microfilter element for removing impurities in the range of about 0.5 µm to about 25.0 µm from fuel, said element comprising a cylindrical filter media and an exoskeleton for the filter media;

the filter media including a filtration layer sandwiched between inner and outer layers;

the filtration layer being made of fiberglass or at least one polymer;

the inner and outer layers being made of a non-woven polymer;

the layers of the filter media being folded into a plurality of longitudinally-extending pleats with a density of about 8 or more pleats per inner diameter inch;

the exoskeleton comprising a support screen bonded to peaks of the pleats to support the pleats in an appropriately spaced and non-collapsed condition;

the support screen providing at least 50% open flow area and a tight array of attachment points so that the filter media is sufficiently supported without having cellulose-fiber and/or woven-mesh endoskeleton support layers.

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